THE

TOPOGRAPHY AND HYDROLOGY

OF

NEW YORK.

BY

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Probably there is no spot in the world so well adapted by nature for the purpose of a commercial entrepôt as the Island on which the city of New York is built. Lying upon the upturned edge of a vast primitive formation, whose upheaval has given it a well defined water-shed, combined with every variety of surface; containing twenty-two superficial square miles, every foot of which is adapted to building purposes, its shores crested by noble rivers rolling into the ocean, pregnant with creative energy; projecting into a bay which contains twenty-four square miles of water surface, and connects with an outer roadstead of 100 square miles in extent; and, to crown all, blessed by a climate of unsurpassed salubrity.

Every year adds its millions of increase to the business of its merchants. New palaces of trade and industry are rising up on every hand, and so it will go on; capital will continue to seek here an investment, and labor its reward, and a few years will find a city rivalling in population, opulence, and splendor, any city of ancient or modern times. If there are those who doubt it, let them look back at the progress of the city for the last thirty years. In 1826 the number of inhabitants was 150,000, and the estimated value of taxable property 100,000,000 dollars. In 1856 the number of inhabitants was 700,000, and the value of taxable property was 500,000,000 of dollars. At this rate of increase in thirty years the number of inhabitants will exceed two millions, and the value of property exceed three billions of dollars.

The sanitary condition of the vast multitude which is accumu-

lating within the limits of the metropolis becomes a matter of vital importance to every citizen. High and low, rich and poor, all are alike interested. In calling attention to what appears to be the principal source of disease and death, it is hoped that the facts set forth may lead to those measures of precaution and remedy which are absolutely necessary to secure the future prosperity of the city.

Of the total number of deaths which take place annually over the whole surface of the globe, nearly one-half are caused by fever in its different forms. To this may be added the number who perish by diseases which originate under circumstances similar to those which produce fever.

It is a well established fact that the principal cause of fever is a humid miasmatic state of the atmosphere, produced by the presence of an excess of moisture in the ground, from which poisonous exhalations constantly arise, vitiating the purer air, and carrying into the system of those who inhale it a virus which, if not sufficiently intense to produce fever, has such a disturbing effect upon the functions of some organ, or set of organs, as to weaken the general system, and act as a powerful predisposing cause of some of the most common and fatal maladies to which the human body is subject. It follows as a matter of course that the first effort to improve the salubrity of any place whatever, should be directed toward preventing the aggregation of water in particular localities, and to remove such as has been allowed to collect.

In order to illustrate more clearly this subject of drainage, let us examine it in connection with a district of country where the surface is in a perfectly natural condition, unaltered or unaffected by any artificial improvements—diversified by hills and valleys, the elevations and depressions forming the water-sheds and water-courses by which the ground is partially relieved of the excess of rain which falls upon it. The evaporation which is constantly going on, under the influence of solar heat upon the waters of the ocean and of the land, carries into the atmosphere large quanti-

ties of water, which, through changes of temperature, becomes condensed,—and descends again upon the earth. But a small portion of that which is annually discharged from the clouds is necessary to vegetation, or is absorbed by the ground. A portion of it passes off on the surface into the rivulets and rivers, and thence to the ocean. Another portion descends through the soil by the force of gravity, until it meets with an impermeable substratum: flowing along this stratum, it either accumulates in hollow basins, or diffuses itself through extensive tracts of subsoil, finding vent in the shape of springs; or by spreading itself over a large mass of soil, it saturates it as a sponge, rendering it unfit for cultivation, creating marshes and swamps, whence arise the malaria so destructive to health. These are visible effects; but there is another condition by means of which this surplus water is rendered injurious to vegetation and to health:—As soon as a portion of water is beneath the surface, it is acted upon by capillary attraction in addition to the force of gravity, the tendency of which is to hold it in suspension, whereby the soil becomes soured and chilled by the evaporation, which carries the water off in the shape of mist, so that even in those sections of country where there is no evidence of marshes or swamps, the nature of the soil may be such as to render it extremely unhealthy.

As the sanitary condition of any city or district of country is so intimately connected with its proper drainage, and the latter is so dependent upon and governed by the topography of the locality, it would appear requisite that any inquiry into the causes or remedies for sanitary evils existing in the city of New York should be based upon a thorough knowledge of the topography of the island upon which it is built; and I have no hesitation in expressing the opinion that one of the chief causes of mortality is to be found in the defective drainage of certain districts of the city; and furthermore, that this is an evil which is increasing as the city extends itself towards the northern portion of the island, and that the main elements by which the evil is

increased are the so-called city improvements, or grading of streets and avenues, which are now being carried forward.

To properly understand the position assumed—it is necessary to bear in mind that the topography of the island of New York varies from 5 to 150 feet above high-water mark; that between these two limits there is every variety of surface. In some sections the topography is of the most intricate description—abrupt ledges of rock, deep and narrow valleys, sudden upheavals and contortions of the geological formations. Winding along this varied surface, in every direction, are the original drainage-streams, one of them of such an extent that it was formerly used for mill purposes.

Now, in laying out the city, the rectangular system of streets and avenues has been adopted, no reference whatever being made to the original topography of the island. The consequence is, that the grading of the streets, especially in the upper part of the city, consists of deep rock excavations and high embankments, some of them as high as forty feet. These embankments cross, of course, the old valleys of drainage, through which flows the drainage-stream of a large area. In most instances a few stones are thrown together and called a culvert, for the purpose of letting these streams pass under the embankments. A few months suffice to destroy these culverts for the purposes of conductors, and the embankments soon become permanent dams, causing the collection of large bodies of water all over the island, which in midsummer become stagnant pools, breeding pestilence and disease.

Whenever it becomes desirable to *improve* the lots adjacent to these embankments for sale or building purposes, earth is dumped in to absorb the water, which is none the less present because it is not seen. The soil, becoming saturated, forms a sort of sponge, through which the water ascends by capillary attraction, giving out a constant miasma, no less fatal to health than the stagnant water which it replaced.

Any system of sewerage, no matter how perfect, would not be a remedy for this evil, for the sewers are but ten or twelve feet below the *grade* of the streets, whilst, as has been stated, in some instances these streams are forty feet below the grade of the streets, being thirty feet between the bottom of the sewer and the water of drainage.

Furthermore, within the corporate limits of the city, more than seven hundred acres have been filled in where the tide once flowed, and the material of this filling has generally been the worst description of earth for such a purpose. The fearful ravages of epidemics in these portions of the city are sufficient evidence of their insalubrity.

Commencing at the Battery, and following the original topography, we find that, previous to the year 1695, an inlet, and subsequently a canal, ran through what is now Broad street, as far as Exchange Place, with a branch running toward the West through Beaver street, afterwards known as the Old Ditch. The main canal was crossed by two principal bridges, one at where is now Bridge street, and the other at Stone street, while at Beaver street there were two smaller bridges for foot passengers. The Long Island ferry-house stood at the corner of New street and Exchange Place, the ferry-boat passing through the canal.

A little further north a stream ran through what is now Maiden Lane. Next above, where is now Ferry street, was Beekman's Park, a large tract of wet land, from which a stream ran into the East River. Next was the Collect Pond, a large body of fresh water, said to have been seventy feet in depth, located in the basin, the site of which is now occupied by the Tombs. On this small lake Fitch launched his first steamboat. A stream called the Wreck Brook ran from the Collect to the East River, through a low meadow; it emptied into the river at the foot of what is now Roosevelt street. There was formerly a bridge across this on the old road, which is now Chatham street.

The main outlet of the Collect was by a stream, running to the North River, through the Lispenard Swamp, which covered a very large surface, extending from Duane street on the south to Spring street. A large stone bridge crossed this stream at Canal street. In the year 1796 a project was submitted by two engineers to the city authorities, for making a dock or basin of the Collect, as a safe harbor for shipping, and to drain and carry off the water from that quarter by means of a ship canal. This shows what an extensive affair this body of water was. So far back as 1805, a committee appointed to examine in the condition of the Collect Pond, reported that it was filed with the bodies of dead animals, and was dangerous to the public health.

It has now disappeared from view, but is more or less present in the soil—as is evidenced by the miasma which has proved so fatal to many poor wretches who have been arrested in a night's debauch, and thrown into the stone cells of the Tombs, never to awake from their drunken sleep.

The next stream above the Collect, on the North River side, was called the Minetta Water, originating in the neighborhood of University Place and Sixteenth street; it emptied into the Hudson near the foot of Hamersley street, passing through what is now Washington Square, and creating a great deal of swampy soil in its course. Where it crossed the old road near Eighth street, there was a bridge, and the stream was twelve feet wide at this point. It is now lost to sight, but very dear to the memory of some people, for it has cost a great many doctors' bills. The physicians can trace the course of this stream by their practice in intermittent fevers. On the opposite side of the city were the Stuyvesant swamps, a very extensive area of low alluvial land, receiving the waters of numerous small streams. Tompkins Square lies in this region. The easterly side of the city is swampy all the way up from here to Kip's Bay.

A considerable stream, creating a great deal of swampy land, received the drainage of Murray Hill and vicinity, passing

through what is now Madison Square and Gramercy Park; so we see there are five public squares located entirely, or in part, in swamps, namely: St. John's, Washington, Tompkins, Madison, and Gramercy. On the westerly side, again, we find a stream emptying into the Hudson at 32d street and 11th avenue, coming all the way from the 6th avenue, and pursuing a very tortuous course, and creating an abundance of swampy soil. Another at 42d street, of nearly the same character and extent.

In the more elevated portions of the island, as the topography becomes more intricate with higher hills and more extensive valleys, the water-courses increase in magnitude. The progress of street grading has obstructed these streams, forming in all directions large deposits of stagnant water, engendering a corresponding amount of fever and ague, from which a large portion of the population of that section of the city are at the present time suffering. In the neighborhood of Broadway, Eighth avenue and 62d street was, until recently, a stagnant pond emitting the most noxious odors; it is now partially obscured by a covering of earth thrown in to bring the lots into the market. The earth, however, is as full of water as a sponge.

A stream originating in this pond runs in a north-westerly direction, then turns and crosses the Central Park diagonally to the corner of 59th street and 5th avenue; here a miserably constructed culvert partly obstructs and dams back the water; crossing 59th street, it passes under the 5th avenue near 58th street; then again crossing 59th street, between 4th and 5th avenues, it passes under the 4th avenue, between 58th and 59th streets; then crossing 58th, 57th, 56th, and 55th streets, between 3d and 4th avenues, it runs into a sewer at the junction of 3d avenue and 54th street. A branch of this stream passes under the Arsenal through a well-constructed conduit, and under the 5th avenue and 64th street, where it debouches to the surface, and crossing 63d, 62d, 61st, and 60th streets, joins the main stream at the junction of 4th avenue and 59th street.

Another large stream rises between 8th and 9th avenues, and running easterly, crosses the Central Park at 74th street; passes under the 5th avenue at 74th street; then crossing 4th avenue and 3d avenue, between 74th and 73d streets, crossing and recrossing 75th street, between 2d and 3d avenues; crossing 2d avenue, and then 74th street, near 1st avenue; crossing and recrossing 74th street, between avenue A and 1st avenue; crossing avenue A between 74th and 75th streets, and avenue B between the same streets, it empties itself into the East River. This stream is more than three miles long. The various turnings are caused by ledges of rocks. A large body of water passes through it, which at one time turned a mill, and the ground throughout its whole course is swampy. It is scarcely necessary for me to go on describing the courses of all the original streams. Those I have described contained almost as much water as has been collected from various sources on Long Island for the Brooklyn Water Works, which have just been completed.

I know that it is generally supposed that when the city is entirely built upon, all that water will disappear; but such is not the case.

The very material which is thrown in to cover it up will form a nucleus for its increase, not only retaining a larger amount of moisture, but will have added to it the drainings through the animal and vegetable refuse which accumulates in all large cities. The fatal consequences which we have already felt are trifling compared to the suffering that will follow the entire occupation of the island. The older cities of Europe give us sufficient evidence of this. They pursued the same course which we are following, and what has been the result? Take, for instance, the city of Glasgow; for five years ending 1840, 55,949 persons were attacked with fever—every fifth person in the city; out of these 4,788 died. We know not at what moment, under a combination of unfavorable circumstances, a pestilence may break out among us; everything is ripe for it, and so sure as it begins, so

sure will it follow the water lines which I have pointed out; it has done it before, and will do it again. It is a remarkable fact that the cholera broke out in 1832, in London, in the very spot where the plague first appeared in 1551 and 1605. In Hamburg, subsequent to the cholera of 1832, the district which suffered the most was thoroughly drained, and when the disease reappeared in 1848, that district was almost exempt.

There is now no doubt that the ravages of the plague in Europe in 1603, 1625, 1636, and 1665, were due to precisely the same causes which foster the diseases to which we have referred. Of this disease there died in—

Florence, ...	60,000
Venice, ...	100,000
Marseilles (in one month), . . .	16,000
Vienna, ...	70,000
Paris, ...	50,000
St. Denis, ...	14,000
Avignon, ...	60,000
Strasburg	16,000
Lubech, ...	9,000
Basle, ...	14,000
Erfurt, ...	16,000
London, ...	100,000

How soon shall New York be prepared to enter this list?

The map will serve to convey some idea of the extent of the evil to which the city is exposed, if the subject of proper drainage continues to be disregarded.

The remedy to be applied in the lower part of the city is to widen the narrow streets, and to raise the grade where the streets pass through the original depression of the surface. Narrow streets, under any circumstances, are a curse to a city. They are too generally the abodes of vice and crime. In them an ordinary sickness spreads into a pestilence, and a fire into a confla-

gration. They are always filthy in summer, and frequently blocked up with snow in winter. They are not fit for business purposes, for they stifle commerce; nor for residence, for they breed disease. Wide streets, on the contrary, are more healthy and cheerful for residences, and more useful and valuable for business purposes. There is less danger from fire, as the flames cannot spread across the street. They are cleaner in summer, and are never impassable in winter. By constructing lateral drains along the slope of the depressions in the lower part of the city, and connecting them with the sewers, they will intercept the water in its descent and prevent its accumulation in the original basins; and then raising the grade, at the same time widening the streets and perhaps discontinuing some of the short and insignificant streets in the sixth ward, the health of the city will be improved one hundred per cent. So far as regards the upper part of the city, it is absolutely necessary that some system should be adopted for the free flow of water along the channels of the original drainage stream. This can be done by building more substantial culverts beneath the streets, and by the construction of permanent drains, so built as to admit of the percolation of water through the interstices of the covering. These drains should be excavated to a firm substratum, and every property owner should be compelled to construct, of a uniform character, that portion of each drain which may pass through his property.

Let us hope that the time is coming when we shall do some credit to the higher intelligence and broader philanthropy which characterize the age in which we live, and shall adopt those measures which are so clear and so imperatively necessary, if we would avoid the want, and woe, and wretchedness which form so many black phases in the history of the cities of Europe. In this money-making, money-wasting generation, let us not be deaf to the lessons of the past. And while we are erecting our marble palaces of trade, rearing our domestic altars in gilded and

frescoed halls, and seeking heaven with the spires of our gothic temples of religion, let us not forget that more than all this splendor surrounded the thrones of the Cæsars, and yet Rome fell under the combined influences of a lawless democracy and the malaria of the Pontine marshes.

In her history we may read our future unless we learn wisdom by her experience.

Topographical Map

of the

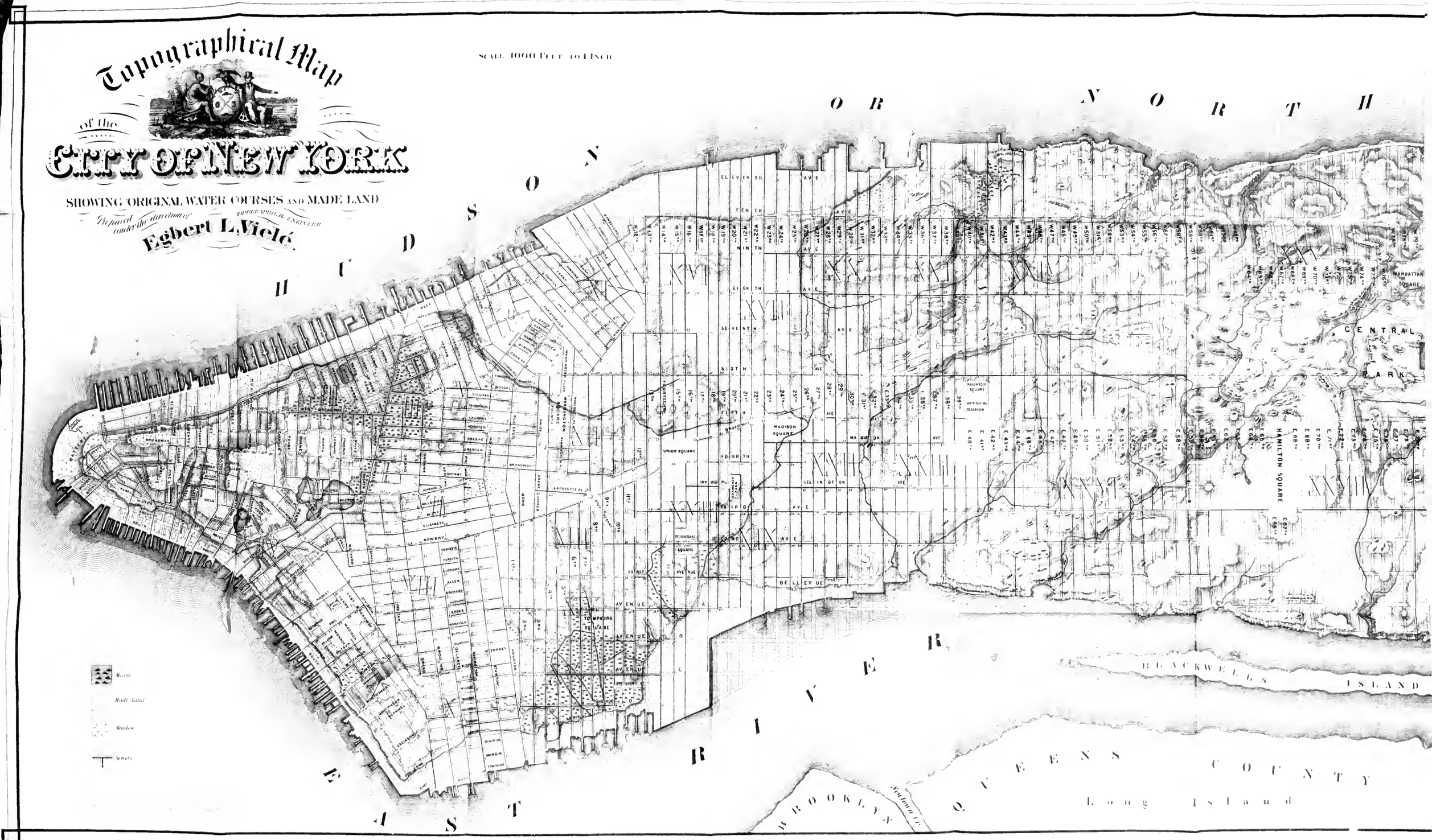
CITY OF NEW YORK

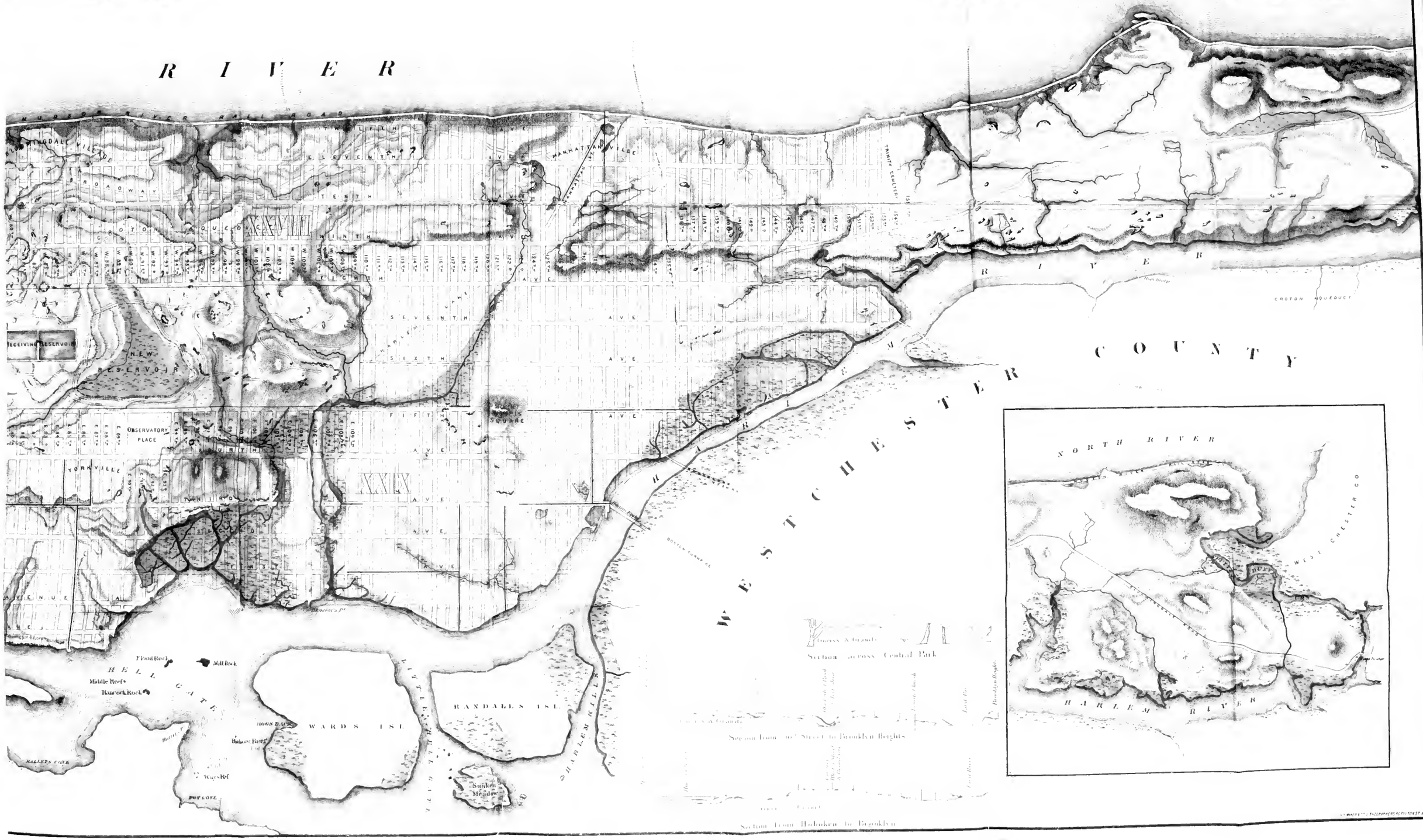
SHOWING ORIGINAL WATER COURSES AND MADE LAND

Prepared under the direction of TOPOGRAPHICAL ENGINEER

Egbert L. Viele.

SCALE 1000 FEET TO 1 INCH




R I V E R
NORTH RIVER
WESTCHESTER COUNTY
EAST RIVER
HARLEM RIVER
HELL GATE
RANDALLS ISL
WARDS ISL
RECEIVING RESERVOIR
NEW RESERVOIR
OBSERVATORY PLACE
YORKVILLE
CROTON AQUEDUCT
TRINITY CEMETERY
Section across Central Park
Section from 10th Street to Brooklyn Heights
Section from Hoboken to Brooklyn